

CLAIMS

I claim:

1. An automated system for applying a fluid to an object comprising:

5 at least one movable arm;  
a compliance mechanism positioned on said arm;  
a fluid dispenser positioned on said compliance mechanism, said fluid dispenser being designed to apply a fluid to the object;

10 means for moving said arm to position said fluid dispenser adjacent the object; .  
means for moving the object relative to said fluid dispenser whereby said fluid dispenser applies a fluid on the object as the object is advanced past said fluid dispenser.

15        2. The system of claim 1 wherein arm is mounted on a  
rotatable post.

3. The system of claim 2 wherein two movable arms are mounted on said rotatable post, said arms being positioned substantially perpendicular to one another.

4. The system of claim 1 wherein said fluid dispenser includes an applicator tip; said applicator tip contacting the object to apply a fluid to the object.

5. The system of claim 4 wherein an applicator tip removal station is positioned along the path of travel of said fluid dispenser, said arm being rotatable to bring said fluid dispenser into proximity to said applicator tip removal station.

6. The system of claim 5 wherein said applicator tip removal station is positioned on a support member.

7. The system of claim 5 wherein said applicator tip removal 5 station includes a stripper bracket for engaging said applicator tip, said stripper bracket engaging said applicator tip and removing said applicator tip from said fluid dispenser as said fluid dispenser is moved relative to said removal station by said arm.

10 8. The system of claim 7 wherein said stripper bracket has a U-shaped portion that defines a slot, said U-shaped portion engages applicator tip as said applicator tip is moved relative to said removal station by said rotation of said arm; said movement of said applicator tip relative to said stripper bracket causing said applicator tip to be removed 15 from said fluid dispenser.

9. The system of claim 8 wherein said U-shaped portion of said stripper bracket has an arcuate surface that engages said applicator tip; said arcuate surface causing said applicator tip to move in a direction 20 away from said fluid dispenser as said applicator tip is moved along said stripper bracket whereby said applicator tip is removed from said fluid dispenser.

10. The system of claim 7 wherein said stripper bracket is 25 connected to a fluid operated cylinder and said fluid operated cylinder is activated to move said stripper bracket into position to engage said applicator tip on said fluid dispenser as said fluid dispenser is moved by said arm.

30 11. The system of claim 4 wherein an applicator tip replacement station is positioned along the path of travel of said fluid dispenser, said

fluid dispenser being movable to bring said fluid dispenser into proximity to said applicator tip replacement station whereby a new applicator tip can be installed on said fluid dispenser.

5        12. The system of claim 11 wherein said applicator tip replacement station is positioned on a support member.

10        13. The system of claim 11 wherein said applicator tip replacement station includes a rack that holds a plurality of applicator tips, said rack having an applicator tip installation area located at one end of said rack; said rack including means for advancing said applicator tips towards said applicator tip installation area.

15        14. The system of claim 13 wherein a rodless fluid operated cylinder is used to advance said applicator tips towards said applicator tip installation area.

20        15. The system of claim 13 wherein said applicator tips in said rack are caused to advance due to the force of gravity.

25        16. The system of claim 13 wherein a fluid operated cylinder is positioned on the side of the applicator tip installation area from said fluid dispenser, said fluid operated cylinder having a rod that can be advanced by said activation of said fluid operated cylinder whereby said applicator tip in said applicator tip installation area of said rack is advanced towards and installed in said fluid dispenser.

30        17. The system of claim 9 wherein said fluid dispenser is mounted on a rotary actuator, said rotary actuator being capable of rotating said fluid dispenser so that said applicator tip on said fluid

dispenser is in the proper orientation for engaging said stripper bracket of said tip removal station.

18. The system of claim 9 wherein said applicator tips used with  
5 said fluid dispenser include a cylindrical cap section that is disposed to  
engage said stripper bracket so that said stripper bracket is capable of  
engaging and removing any applicator tip used with said fluid dispenser.

19. The system of claim 4 wherein a fluid dispenser with an  
10 applicator tip is positioned on each arm, said applicator tip on one arm  
being different from said applicator tip on said other arm.

20. The system of claim 19 wherein said applicator tip on the  
fluid dispenser on one arm has a different orientation from the applicator  
15 tip on the fluid dispenser on said other arm.

21. The system of claim 4 wherein a first fluid is supplied to one  
fluid dispenser positioned on said one arm and second fluid is supplied  
to said other fluid dispenser positioned on said other arm.

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22. The system of claim 21 wherein said first fluid and said  
second fluid are selected from primers, adhesives, abrasives, mastic  
bonding materials, masking liquids and cleaning compounds.

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23. The system of claim 21 wherein multiple fluids can be  
supplied to each fluid dispenser so that said fluids are dispensed in a  
desired sequence.

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24. The system of claim 4 including a docking station having a  
receptacle for said applicator tip positioned on said fluid dispenser, said

receptacle providing a location to store said applicator tip when said applicator tip is not being used to apply fluid to an object.

25. The system of claim 24 wherein said docking station  
5 functions to keep contamination from coming into contact with said applicator tips when said applicator tips are not being used to supply fluid to the object.

26. The system of claim 25 wherein said docking station  
10 encloses said applicator tip in an environment that minimizes changes in said fluid supplied to said applicator tip for coating the object.

27. The system of claim 26 wherein said docking station is  
disposed to engage said applicator tip when said applicator tip moves  
15 away from the object and said applicator tip is not being used to apply fluid to the object.

28. The system of claim 26 wherein said docking system  
includes a reservoir of a solvent, said solvent in said reservoir acting  
20 upon said applicator tip to maintain said applicator tip and fluid in said applicator tip in condition for applying said fluid to the object.

29. The system of claim 1 wherein a fluid supply system is  
operatively connected to said fluid dispenser, said fluid supply system  
25 having a sealed container for said fluid.

30. The system of claim 1 including a closed container to supply  
said fluid to said fluid dispenser, said container having an atmosphere  
positioned over said fluid in said container whereby said atmosphere does  
30 not interact with said fluid.

31. The system of claim 29 wherein said sealed container is provided with means for introducing an inert gas to the interior of said sealed container to produce a controlled atmosphere over said fluid.

5 32. The system of claim 31 wherein said inert gas is nitrogen.

10 33. The system of claim 28 wherein a metering pump is used to supply fluid from said container to said fluid dispenser, said metering pump being capable of supplying very precise amounts of fluid to said fluid dispenser.

15 34. The system of claim 33 wherein said metering pump can be cycled on and off to control the supply of fluid to said fluid dispenser and applicator tip whereby the desired amount of fluid is present in said applicator tip to apply a desired coating of fluid to the object.

20 35. The system of claim 34 wherein said metering pump is cycled on and off to meter the flow of fluid to said fluid dispenser and applicator tip to match variations in the surface speed of the object that is moving past the applicator tip during the application of fluid to the surface of the object.

25 36. The system of claim 35 wherein said fluid dispenser includes a needle valve that can be moved to shut down the flow of fluid through said fluid dispenser, said needle valve being moved in combination with said on and off cycling of said metering pump to control the quantity of fluid supplied to said applicator tip to obtain the desired deposition of fluid on the object over a range of changes in surface speed of the surface of the object that is moved past said applicator tip during the application of fluid on the object.

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37. The system of claim 36 wherein said needle valve defines an orifice in said fluid dispenser, said fluid that is applied to the object passing through said orifice, said position of said needle valve in said fluid dispenser being adjustable whereby the size of said orifice can be  
5 varied to accommodate fluids with different viscosities or rheology.

38. The system of claim 36 wherein said applicator tip is constructed to have good fluid retention properties whereby fluid is retained in said applicator tip when said supply of fluid to said applicator  
10 tip is interrupted whereby said fluid is applied in the quantity and location where desired on the object.

39. The system of claim 31 wherein a plastic liner is positioned in said sealed container, said plastic liner being disposed to hold said  
15 fluid, said plastic liner being constructed to be disposable to assist in changing said fluid in said container.

40. The system of claim 1 wherein at least one sensor is positioned on said arm to measure the position, thickness or uniformity  
20 of the fluid applied to the object.

41. The system of claim 1 wherein said compliance mechanism maintains a fluid applicator in contact with the surface of an object to which a fluid is being applied and includes:

25 an L-shaped bracket having a first leg and a second leg;  
a first tab positioned at the end of said first leg and a second tab positioned at the end of said second leg;  
30 a first dual acting fluid operated cylinder slidably positioned on said first leg of said L-shaped bracket, said first cylinder having a piston rod that extends from said first cylinder, said fluid actuation of said cylinder causing said piston rod to be advanced relative to said first

cylinder, said end of said piston rod that extends from said first cylinder being secured to said first tab;

5 a second dual acting fluid operated cylinder slidably positioned on said second leg of said L-shaped bracket, said second cylinder having a piston rod that extends from said second cylinder, said fluid actuation of said cylinder causing said piston rod to be advanced relative to said second cylinder, said end of said piston rod that extends from said second cylinder being secured to said second tab;

10 a fluid applicator positioned on said first cylinder for applying a fluid to the object, said first cylinder allowing said fluid applicator to move relative to the object in first direction and said second cylinder allowing said fluid applicator to move relative to the object in a second direction whereby said fluid applicator is maintained in contact with the object during the application of said fluid to the object.

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42. The system of claim 41 wherein said first and second cylinders can be biased towards the object by having a pressure differential present in one of said cylinders.

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43. The system of claim 42 wherein a linear ball bearing is used to position said first and second cylinders on said first and second legs wherein there is very little resistance to movement of said first and second cylinders.

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44. The system of claim 42 wherein said first and second cylinders create a biasing force from about 5 ounces to about 40 ounces on said fluid applicator.

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45. The system of claim 41 wherein said second dual acting cylinder is operatively connected to a movable support arm for positioning said compliance mechanism relative to the object.

46. The system of claim 45 wherein said second dual acting cylinder is connected to a positioning plate that is disposed at an angle with respect to said second dual acting cylinder, said positioning plate being releasably secured to a positioning member on said support arm 5 whereby said positioning plate can be rotated on said positioning member to change the position of said compliance mechanism with respect to the object to be coated.

47. The system of claim 46 wherein a releasable securing means 10 secures said positioning plate to said positioning member.

48. The system of claim 45 wherein said second dual acting cylinder is operatively connected to a rotary actuator that can be caused to rotate to position said compliance mechanism with respect to the 15 object that is to be coated.

49. A system for applying a fluid to an object comprising:  
a container for supplying said fluid;  
an applicator tip to apply said fluid to the object;  
20 a small diameter tube extending from said container to said applicator tip to supply fluid to said applicator tip for applying said fluid to the object; and  
a pump operatively connected to said tube whereby said pump acts to move said fluid from said container, along said tube to 25 said applicator tip.

50. The system of claim 49 wherein said small diameter tube has a diameter from about 1/16 to about 5/16 of an inch.

30 51. The system of claim 49 wherein a fluid dispenser is provided that includes a tip region, said tip region being designed so that said

applicator tip can be removably positioned on said tip region, said fluid dispenser defining a passageway that extends through said tip region to supply fluid to said applicator tip, said small diameter tubing extending through said passageway to supply fluid to said applicator tip.

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52. The system of claim 51 wherein said fluid dispenser includes a tube lock that allows said tube to be inserted into said passageway in a direction whereby said tube can only be advanced through said tip region in a direction towards said applicator tip.

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53. The system of claim 52 wherein said tube lock prevents said small diameter tubing from being removed from said fluid dispenser when said applicator tip is on said fluid applicator.

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54. The system of claim 51 wherein said applicator tip defines a cavity that is in fluid communication with the passageway in said fluid applicator, said small diameter tubing extending into said cavity in said applicator tip to supply said fluid directly to said applicator tip.

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55. The system of claim 54 wherein said cavity is designed to snugly engage said small diameter tubing whereby said fluid supplied through said small diameter tubing is directed only to said applicator tip.

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56. The system of claim 55 wherein said small diameter tubing extends from said tip region of said fluid dispenser and into said cavity in said applicator tip.

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57. The system of claim 56, wherein said system is cleaned after use by removing said applicator tip and advancing said small diameter tubing from said container and said fluid applicator whereby all

of said fluid is retained in said small diameter tubing and said fluid does not contaminate said container, said pump or said fluid applicator.

58. The system of claim 49 wherein said pump is a positive  
5 displacement pump.

59. The system of claim 49 wherein said pump is a peristaltic  
pump.

10 60. The system of claim 59 wherein said peristaltic pump acts  
upon said small diameter tubing to advance said fluid from said container  
to said applicator tip.

15 61. The system of claim 49 wherein said container has an  
opening at one end and a closure that closes said opening, said closure  
having a first port that passes through said closure, said small diameter  
tubing passing through said first port and into communication with said  
fluid in said container.

20 62. The system of claim 61 wherein said closure has a second  
port that is in communication with the atmosphere to allow air to enter  
said container as said fluid in the container is removed through said small  
diameter tubing.

25 63. The system of claim 62 wherein a desiccant container is  
connected to said second port whereby moisture is removed from said  
air that enters said container through said second port.

30 64. The system of claim 61 wherein said closure has a fitting  
that is disposed in communication with said first port, a tee fitting having  
three openings being secured with one of said openings being in

engagement with said fittings on said closure, said small diameter tubing extending through one of said other openings in said tee fitting and extending through said tee fitting, the fitting on said closure, the first port in said closure and into the container.

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65. The system of claim 64 wherein said opening on said tee fitting through which said small diameter tubing extends sealing around said small diameter tubing to substantially prevent air from entering into said tee fitting through the opening containing said small diameter tubing.

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66. The system of claim 65 wherein said remaining opening on said tee fitting is operatively connected desiccant container, said desiccant container being open to the atmosphere whereby moisture is removed from the air that enters said tee fitting and through said tee fitting to said container.

67. The system of claim 66 wherein the opening on said tee fitting that is connected to said desiccant container being sealed to said desiccant container to substantially prevent air from entering into said tee fitting except through said desiccant container.

68. The system of claim 64 wherein said tee fitting has a tube lock that engages said small diameter tube and allows said small diameter tube to be advanced through said tee fitting in a direction towards said container.

69. The system of claim 49 wherein said container is mounted on a shaker whereby the fluid in said container can be shaken during application of said fluid to the object.

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70. The system of claim 58 wherein said positive displacement pump engages and constricts said small diameter tube when said positive displacement pump is not activated to pump fluid through said small diameter tube.

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71. An automated system for applying a fluid to an object comprising:

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at least one movable arm;  
a compliance mechanism positioned on said arm;  
a fluid dispenser operatively connected to said compliance mechanism, said fluid dispenser being designed to apply a fluid to the object;

means for positioning said arm whereby said fluid dispenser is positioned adjacent the object;

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means for providing relative movement between the object and said fluid dispenser whereby said fluid dispenser applies a fluid on the object as the object and said fluid dispenser move relative to one another.

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72. The system of claim 71 wherein said fluid dispenser includes an applicator tip; said applicator tip contacting the object to apply a fluid to the object.

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73. The system of claim 72 wherein an applicator tip removal station is positioned along the path of travel of said fluid dispenser, said arm being moveable to bring said fluid dispenser into proximity to said applicator tip removal station.

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74. The system of claim 73 wherein said applicator tip removal station includes a stripper bracket for engaging said applicator tip, said stripper bracket engaging said applicator tip and removing said applicator

tip from said fluid dispenser as said fluid dispenser is moved relative to said removal station by said arm.

75. The system of claim 74 wherein said stripper bracket has a  
5 U-shaped portion that defines a slot; said U-shaped portion engages  
applicator tip as said applicator tip is moved relative to said removal  
station, said movement of said applicator tip relative to said stripper  
bracket causing said applicator tip to be removed from said fluid  
dispenser.

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76. The system of claim 75 wherein said U-shaped portion of  
said stripper bracket has an arcuate surface that engages said applicator  
tip; said arcuate surface causing said applicator tip to move in a direction  
away from said fluid dispenser as said applicator tip is moved along said  
15 stripper bracket whereby said applicator tip is removed from said fluid  
dispenser.

77. The system of claim 74 wherein said stripper bracket is  
connected to a fluid operated cylinder and said fluid operated cylinder is  
20 activated to move said stripper bracket into position to engage said  
applicator tip on said fluid dispenser as said fluid dispenser is moved by  
said arm.

78. The system of claim 72 wherein an applicator tip  
25 replacement station is positioned along the path of travel of said fluid  
dispenser, said fluid dispenser being movable to bring said fluid dispenser  
into proximity to said applicator tip replacement station whereby a new  
applicator tip can be installed on said fluid dispenser.

79. The system of claim 71 wherein said fluid dispenser is mounted on a rotary actuator, said rotary actuator being capable of rotating the fluid dispenser.

5 80. The system of claim 79 wherein said rotary actuator is positioned on said compliance mechanism.

10 81. The system of claim 80 wherein more than one fluid dispenser is mounted on said rotary actuator whereby said rotary actuation can be activated to position different fluid dispensers in position to coat the object.

15 82. The system of claim 81 wherein said fluid dispenser can be used to apply different fluids to the object.

83. The system of claim 82 wherein said fluid dispensers can be used to apply fluid to different areas of the object.

20 84. The system of claim 79 wherein said fluid dispenser includes an applicator tip, said applicator tip contacting the object to apply a fluid to the object.

25 85. The system of claim 84 wherein said rotary actuator can be used to change the orientation of said applicator tip with respect to the object whereby said fluid applied to the object is changed.

30 86. The system of claim 72 wherein a docking station is movably mounted on said compliance mechanism, said docking station being disposed in proximity to said applicator tip whereby said docking station keep contaminants from coming into contact with said applicator

tip and to maintain said applicator tip in condition for applying fluid to the object.

87. The system of claim 86 wherein ~~said~~ rotary actuator can be  
5 activated to move said applicator tip into position relative to said docking station.

88. The system of claim 87 wherein said docking station defines a chamber that is positioned around said applicator tip, said chamber including a pad along at least one wall of said chamber adjacent said applicator tip.  
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89. The system of claim 88 wherein a fluid reservoir is positioned on said docking station, said fluid reservoir being in communication with said pad whereby fluid in said reservoir can saturate said pad to provide a desired atmosphere adjacent said applicator tip.  
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90. The system of claim 89 wherein said pad acts to wick said fluid from said reservoir.  
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91. The system of claim 90 wherein said reservoir contains at least one opening that is in fluid communication with said pad.

92. The system of claim 72 wherein said docking station is mounted on a bracket, said bracket having at least one aperture, said compliance mechanism having a plurality of pins that are positioned for extending into said at least one aperture on said bracket whereby said bracket can be positioned on the pins of said compliance mechanism to properly position said applicator tip.  
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93. The system of claim 71 wherein said fluid dispenser includes a spherical bearing and a swivel member operatively positioned in said spherical bearing said swivel member having a tip region upon which said applicator tip is mounted whereby said fluid dispenser is capable of 5 movement in one direction to accommodate changes on the object that is to be coated.

94. The system of claim 93 wherein a passageway extends through said swivel member and said tip region of said swivel member.

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95. The system of claim 94 wherein a small diameter tube is positioned in said passageway to provide fluid to said applicator tip mounted on said tip region of said swivel member.

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96. The system of claim 95 wherein said small diameter tube provides a biasing force to said swivel member to urge said swivel member into a center position in said spherical bearing.

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97. The system of claim 72 including a container for supplying said fluid and a small diameter tube that extends from said container to said fluid applicator tip whereby said fluid is maintained in said small diameter tube and said applicator tip and said fluid does not contact other components of said system.

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98. The system of claim 97 wherein a pump is operatively connected to said tube whereby said pump acts to move said fluid from said container, along said tube to said applicator tip.